

## DISPROPORTIONATION PROCESSES

Disproportionation is a form of direct reduction wherein the metal is generally produced in a two stage reaction.



The reaction can be run with any aluminum compound such as chloride or fluoride. The CO off-gas can be utilized in a gas turbine to generate substantial electrical power.

If one considers that direct reduction occurs in one step and that some of the aluminum produced is soluble in the salt medium because of the activity of the aluminum ion in the salt which then disproportionates as the salt cools, then the disproportionation can be considered as a one step direct reduction reaction taking place in a salt medium rather than in some atmosphere as would occur in a typical blast furnace operation. If direct reduction is carried out in some atmosphere, then the aluminum is a vapor and back reacts with CO to form carbides and oxides. Consequently, direct reduction has not been developed to an acceptable commercial process. Alternatively alloying elements such as silicon, iron, etc., are used to capture the aluminum and prevent total back reaction, but an alloy is produced rather than a high purity primary aluminum.

If direct reduction is conducted in a salt medium with a high aluminum compound composition to provide high aluminum ion activity which will result in a high aluminum metal solubility in the salt at reduction temperature, then the CO can pass out of the salt medium with little or no back reaction. Then as the salt is cooled in a cyclic heat exchanger the aluminum will become insoluble and/or disproportionate to yield aluminum metal with a purity equivalent to the feed alumina. It is anticipated that an electric arc would be used to generate the necessary heat for the direct reduction which would be equivalent to a submerged arc operation. Much of the electric power could be generated from the CO off-gas.

Three disproportionation reactions have been run at Tucson, that were not arcs, with one yielding aluminum. It is felt there is a reasonable probability of success for a submerged arc to work for producing aluminum or magnesium and that ARCO Metals could develop a proprietary position.